

UNITED STATES PATENT APPLICATION

of

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for

WATER-INDICATING ENDODONTIC MONITORING DEVICES

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WATER-INDICATING ENDODONTIC MONITORING DEVICES

BACKGROUND OF THE INVENTION

1. The Field of the Invention

[0001] The present invention relates to endodontics, more particularly to a device and method for easily determining whether moisture is present within the root canal of a tooth prior to sealing the root canal.

2. The Relevant Technology

[0002] When a dental practitioner performs a root canal, pulp and other material in the root canal chamber is removed. Once a dentist has removed diseased and soft tissue from a tooth's root canal, the chamber must be filled. Before the canal can be filled with gutta percha or another suitable material, any moisture present within the canal must be removed. It is important to remove the moisture, which could otherwise result in bacterial infection of the chamber. Moisture can also inhibit bonding between the root canal walls and a sealant, if used.

[0003] In some instances, pressurized air has been used to dry the canal, but because the source of pressurized air often contains even a small amount of moisture that can condense in the canal, use of this method is discouraged.

[0004] Dental practitioners have attempted to dry the canal by using cotton swabs or paper points which can be inserted down into the canal. Because of the large size of cotton swabs and the narrow cross sections of the canals, especially in the apical region, completely removing all of the moisture may prove difficult. Paper points are more easily inserted into the canal, and are especially useful as they are able to extend through curved and narrow

portions of the canal, but it can still be difficult to determine whether all the moisture has been removed from the canal.

[0005] It would be an improvement in the art to provide a device and method which may be used to easily and accurately determine whether moisture is present within a root canal.

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BRIEF SUMMARY OF THE INVENTION

[0006] The present invention relates to an endodontic device that can be used for detecting the presence of moisture within a root canal. According to one embodiment, the device comprises an endodontic cone formed of a water absorptive material and a chemical indicator comprising at least one cobalt salt applied to the water absorptive material. The chemical indicator changes color when moistened with water.

[0007] The endodontic cone may be formed of paper or other material that is water absorptive. The endodontic cone may be sprayed, dipped, or otherwise coated or impregnated with a moisture sensitive chemical indicator comprising at least one cobalt salt.

[0008] The chemical indicator may be applied as an aqueous solution. The solution may also include a wetting agent, such as ethanol, and/or a surfactant, such as Silwet. Once applied, the solution is allowed to dry so as to be substantially free of moisture. Once dried, the endodontic device is ready for use.

[0009] In use, the device may be inserted into the root canal of a patient's tooth. Because the device includes a color-changing chemical indicator, if moisture is present within the root canal, the chemical indicator will change color, indicating the presence of moisture. In this way, the practitioner is alerted to the presence of moisture within the root canal. If moisture is detected, the practitioner may insert additional devices into the root canal until the root canal is dry. The practitioner will be alerted that the canal is dry when the inserted device does not change color.

[0010] In addition to detecting the presence of moisture, it may sometimes be desirable to detect the presence of sodium hypochlorite. Once the practitioner abrades and cleans the pulp tissue out of the root canal, sodium hypochlorite may be introduced in order to disinfect the canal prior to drying and eventually sealing the canal. Once used to disinfect the canal,

the sodium hypochlorite may then be rinsed out with water. Because of this, it may be desirable to use a device that includes a cobalt salt that also changes to a different color to indicate the presence of sodium hypochlorite. This allows the practitioner to be certain that all the sodium hypochlorite has been removed from the root canal chamber.

[0011] These and other advantages and features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0012] To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by references to specific embodiments thereof, which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0013] Figure 1A is a perspective view of a piece of water absorptive material having a triangular shape;

[0014] Figure 1B is a perspective view of the water absorptive material of Figure 1A, the material being partially rolled so as to form an endodontic cone;

[0015] Figure 2 is a perspective view of an exemplary device according to the present invention;

[0016] Figure 3 is a cross sectional view of a patient's tooth with the device of Figure 2 inserted into the root canal of the tooth;

[0017] Figure 4 is a perspective view of the device of Figure 3 after withdrawing the device from the root canal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

I. Introduction

[0018] The present invention relates to a device for detecting moisture within a root canal chamber. The device comprises an endodontic cone formed of a water absorptive material (e.g. paper) that includes a moisture sensitive chemical indicator applied to the water absorptive material. The chemical indicator comprises at least one cobalt salt that changes color when moistened with water.

II. Exemplary Device and Method of Manufacture

[0019] Figure 1A is a perspective view of a piece of water absorptive material 10, such as paper. The material 10 is illustrated as having a generally triangular shape. Figure 1B illustrates the water absorptive material 10 being rolled into a cone shape, having a tip 12 at one end, while Figure 2 illustrates the water absorptive material 10 having been tightly rolled into an endodontic cone. The device 20, as illustrated in Figure 2 comprises a water absorptive material 10 and a chemical indicator comprising at least one cobalt salt that is applied to the water absorptive material.

[0020] The chemical indicator comprises at least one cobalt salt. Suitable cobalt salts include various cobalt halides, such as cobalt fluoride, cobalt chloride, and cobalt iodide. Another suitable cobalt salt includes cobalt sulfate. Cobalt chloride is one particularly preferred cobalt salt. When dry, cobalt chloride is dark blue, and when exposed to moisture it turns a bright pink. If exposed to sodium hypochlorite, it turns black. The nature of the color changes, especially from dark blue to bright pink, are very pronounced, making it easy for the dental practitioner to recognize.

[0021] The chemical indicator may be applied as an aqueous solution that includes the color changing chemical indicator. The aqueous solution may include a wetting agent and/or a surfactant in addition to water and the chemical indicator comprising a cobalt salt. The cobalt salt may be included in an amount ranging from about 0.5% to about 50% by weight, preferably about 5% to about 40% by weight, and more preferably about 10% to about 30% by weight.

[0022] Ethyl alcohol may be included as a wetting agent, in an amount up to about 10%, preferably about 5%. Silwet may be included as a surfactant in an amount up to about 1%, preferably about 0.5%. The remainder of the aqueous solution comprises water (ranging from about 10% to about 99.5% by weight).

[0023] The aqueous solution may be applied by spraying, dipping, or otherwise coating or impregnating the water absorptive material 10 so that the chemical indicator is applied to the water absorptive material 10.

[0024] Once the aqueous solution has been applied, the material 10 with the applied aqueous solution are dried so as to be substantially free of moisture. It may be oven dried or allowed to air dry. The finished endodontic device 20 is illustrated in Figure 2.

[0025] According to an alternative process for manufacturing a water indicating endodontic device, an aqueous pH changing solution is applied to the endodontic cone by spraying or dipping. The pH changing solution comprises a pH changing material (*e.g.* CaO, KOH, or K₂CO₃) in aqueous solution. In one embodiment, the pH changing material is present in an amount of about 0.01% to about 0.5% by weight. The treated endodontic cone is oven dried to produce a dry, treated endodontic cone. An anhydrous pH sensitive indicator solution comprising a pH sensitive color changing indicator (*e.g.* phenolphthalein) and an anhydrous volatile solvent (*e.g.* isopropanol or ethanol) is then applied to the endodontic cone by

spraying or dipping. In one embodiment, the anhydrous pH sensitive indicator solution may comprise from about 0.01% to about 0.5% phenolphthalein. The endodontic cone is then allowed to dry.

[0026] In use, when water contacts the endodontic device for detecting moisture, the dried pH changing material (*e.g.* CaO) will cause the pH of the water to rise and react with the pH sensitive color-changing indicator (*e.g.* phenolphthalein) to change the color of the device, indicating moisture in the root canal chamber. In another embodiment, an acidic pH changing material, (*e.g.* citric acid) may be used with a pH sensitive color changing indicator that changes color at lower pH.

III. Exemplary Method of Use

[0027] Figure 3 illustrates an exemplary tooth 30 where the root canal 32 has been treated using endodontic treatment devices and techniques known in the art. In one embodiment, the root canal 32 is further cleaned and disinfected using an antimicrobial rinse (*e.g.* a solution including sodium hypochlorite). Once the root canal 32 has been properly cleaned, the water-indicating device 20 is inserted into the root canal 32 in order to remove any residual moisture. Before inserting the device 20, the device 20 has a first color. For example, if the cobalt salt used is cobalt chloride, the device 20 has a dark blue color when dry and before insertion into the root canal 32.

[0028] The water absorbing material 10 of the device 20 may be paper, which is sufficiently flexible to allow the device 20 to be inserted through curved areas of the root canal chamber 32. If moisture is present within the root canal chamber, it will be absorbed by water-absorbing material 10, causing the chemical indicator that is on or impregnated into the material 10 to change color. In this manner, the device 20 serves both the purpose of



removing residual water (and other residual materials such as sodium hypochlorite) from the canal, while also indicating to the dental practitioner whether or not moisture is present in the root canal 32.

[0029] The device 20 is then withdrawn from the root canal 32. A quick visual inspection by the dental practitioner will reveal whether the chemical indicator has changed color. Figure 4 illustrates the device 20 after having been withdrawn from root canal 32. A portion of the device adjacent to the tip 12 has changed color, indicating the presence of moisture within the root canal chamber 32. For example, if the chemical indicator is cobalt chloride, it will change from a dark blue (dry condition) to a bright pink (wet condition) if moisture was present in the root canal chamber 32. If sodium hypochlorite was also present in the root canal chamber 32, the chemical indicator will instead change to black. If sodium hypochlorite is present in the root canal 32, it may be desirable to further rinse the root canal 32 with water until no more sodium hypochlorite is detected.

[0030] The dental practitioner may continue to insert and withdraw additional devices 20 from the root canal chamber 32 so as to remove any moisture remaining in the canal 32. When the withdrawn device has the same dark blue color as when inserted, the dental practitioner knows that the root canal 32 is dry, and may then proceed to seal the canal as known in the art.

IV. Examples Of The Preferred Embodiments

[0031] The following are several examples of aqueous compositions according to the invention that can be used to manufacture water-indicating points. The exemplary formulations and manufacturing conditions are given by way of example, and not by limitation, in order to illustrate compositions that have been found to be useful for indicating

the presence of water in a root canal. Unless otherwise indicated, all percentages are by weight.

EXAMPLE 1

[0032] An aqueous composition used to manufacture water-indicating points according to the invention was made by mixing together the following components:

Cobalt Chloride	20%
Ethyl Alcohol	5%
Silwet	0.5%
Water	74.5%

[0033] The aqueous composition was sprayed onto a plurality of paper points. The wetted points were then placed into an oven to dry. The dried water-indicating points were blue. When wetted with water they turned pink. When wetted with aqueous sodium hypochlorite, they turned black.

EXAMPLE 2

[0034] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	10%
Ethyl Alcohol	10%
Silwet	0.5%
Water	79.5%

[0035] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 3

[0036] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	5%
Ethyl Alcohol	15%
Silwet	0.5%
Water	79.5%

[0037] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 4

[0038] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	2%
Ethyl Alcohol	15%
Silwet	0.5%
Water	82.5%

[0039] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 5

[0040] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	30%
Ethyl Alcohol	5%
Silwet	1%
Water	64%

[0041] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 6

[0042] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	40%
Ethyl Alcohol	4%
Silwet	2%
Water	54%

[0043] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 7

[0044] An aqueous composition used to manufacture water-indicating points according to the invention is made by mixing together the following components:

Cobalt Chloride	50%
Ethyl Alcohol	2%
Silwet	2%
Water	46%

[0045] The aqueous composition is used to manufacture a water-indicating point using the process of Example 1.

EXAMPLE 8

[0046] Any of the foregoing aqueous compositions is modified by replacing the cobalt chloride with one or more of cobalt fluoride, cobalt iodide or cobalt sulfate and then used to manufacture a water-indicating point.

EXAMPLE 9

[0047] A pH changing solution used to manufacture water-indicating points according to the invention was made by mixing together the following components:

CaO	0.1%
Water	99.9%

[0048] The pH changing solution was sprayed onto a plurality of paper points. The wetted points were then placed into an oven at about 105°C to dry. The dried, treated paper points were then sprayed with an anhydrous pH sensitive indicator solution made by mixing together the following components:

Phenolphthalein	0.1%
Isopropanol	99.9%

[0049] The wet paper points were again allowed to dry. When wetted with water they turned from white to pink.

[0050] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered

in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

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